

PATENT SPECIFICATION

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(54) SANITARY ARTICLES

- (71) We, CELANESE CORPORATION, of 522 Fifth Avenue, New York 36, State of New York, United States of America, a company incorporated in accordance with the laws of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to readily disposable sanitary articles such as diapers and sanitary napkins.
- Sanitary articles, such as diapers, which are intended to be disposed of after a single use are known. Such articles if so made that they resist disintegration when wet with body fluids are liable to cause plugging of the plumbing system when deposited in the domestic toilet pan unless first subjected to tearing or shredding which is neither convenient or pleasant. The present invention is concerned with disposable sanitary articles which do not suffer from this disadvantage.
- According to the invention a diaper, sanitary napkin or like sanitary article consists of a body of biodegradable fibres held together with a water-insoluble copolymer of at least two monomers which include an ethylenically unsaturated mono- or poly-carboxylic acid and an ethylenically unsaturated ester or nitrile, which copolymer is free from irreversible crosslinking, is non-irritating to the human skin and, while stable to fluid body discharge, degrades to release said fibres in more alkaline liquids, said article exhibiting dry and wet strengths and breaking elongations such that a one inch wide strip thereof withstands without breaking pulls of at least two pounds when dry and at least 0.5 pounds when wet and extends before breaking by from 3 to 50% of its length when dry and from 3 to 25% of its length when wet.
- The sanitary articles of the invention are inexpensive enough to dispose of after a single use, possess sufficient wet and dry strengths and elongations to maintain their structural integrity under the conditions of use and during handling, folding and packaging and can be readily, easily and safely disposed of in a domestic toilet system without the need for tearing with the aid of a small quantity of readily available alkaline substances.
- In addition to diapers, other sanitary articles within the scope of this invention are catamenial devices such as sanitary napkins or vaginal tampons and pads for protecting the bed against wetting.
- Fluid body discharges broadly range in pH from extremes of 4.6 to 8.4 so that the copolymers used as binders to hold together the biodegradable fibres must be stable in the slightly alkaline and slightly acidic discharge encountered during use. Quite obviously, the exact pH encountered within the broad range set forth varies depending upon many factors including the specific end use. Thus, diapers and sanitary napkins are not necessarily subjected to the same pH ranges during use. Therefore, the binders employed need be stable only in the particular body discharge encountered during use.
- The binders employed must not be irritating to the human skin and, when combined with biodegradable fibres, the resulting product should possess a pleasing hand or feel. A test method has been devised to determine whether or not a possible binder is irritating to the human skin. In this test a sample one inch square is applied to the skin and held in place with adhesive tape and, after 48 hours, the sample is removed and 10 to 14 days allowed to elapse. The test is then repeated for an additional 48 hours. If any redness, scaliness or accumulation of fluid in the skin occurs the polymer is considered unsuitable. The expression "non-irritating to the human skin" as used in the specification and claims is intended to define a polymer which satisfies this test procedure which is more fully described in The Public Health Report, United States of America, Vol. 59,

1944 under Prophetic Patch Test at page 551.

5 The wet and dry strengths and elongations which characterize the sanitary articles are essential for these products to function properly. The values specified for these properties are obtained by the use of a conventional "Instron" (Registered Trade Mark) Testing Machine wherein a sample strip one inch by
10 six inches cut from the article to be tested is conditioned by maintaining it at 73.4° F. and 50% relative humidity for 48 hours and then inserted into the rubber-faced jaws of the Instron Testing Machine to a gauge
15 length of two inches and tested at an elongation rate of four inches per minute. For determination of wet strength and wet elongation the sample strip is soaked in water having a pH of approximately 7 for 10
20 minutes after the 48-hour conditioning treatment and then tested.

25 The biodegradable fibres used in the articles of the invention may be, for example, protein fibres, e.g. silk or wool, although cellulosic fibres are preferred, for instance, regenerated cellulose, i.e. rayon, wood pulps of moderate alpha cellulose content or cotton linters. It is advantageous to use fibres less than 1/2 inch long and, especially, less than
30 1/4 inch long.

35 Examples of copolymers which may be used to hold together the biodegradable fibres are copolymers of acrylic or methacrylic acid with an alkyl acrylate or methacrylate, e.g. ethyl acrylate or methyl methacrylate, or with acrylonitrile, if desired, together with styrene.

40 The binder can be applied to the fibres by spraying, by dipping the fibres into a solution of the binder or by coating the binder onto the fibres. The mixture of fibres and binder is then used to prepare sanitary articles.

45 The amount of binder which is employed should be carefully controlled since too little binder will not yield a product of sufficient strength whereas too much binder will result in a product which cannot be degraded in a reasonable time in a toilet. In this connection, it has been found that suitable sanitary products can be obtained when cellulosic fibres
50 are held together with from 10 to 60 weight percent of the copolymer used according to the invention as binder (based on total weight of fibres and binder).

55 A preferred embodiment of this invention resides in the production of disposable sanitary articles with alkali degradable binders having degradable values (D) not greater than 5 and, especially, not greater than 3, the D values being determined as follows:—

60 A sample bonded fibre strip two inches long and one inch wide, consisting of cellulosic fibres less than 1/2 inch long bonded together with 30% by weight of a candidate binder (based on total weight of fibres and
65 binder), is heated to a temperature of 90°

C. for 10 minutes, and then placed in one litre of water at room temperature to which is added 2 cc of 1.0 Normal NaOH. The test sample is then stirred in the alkaline solution and the time in minutes (D) for the binder
70 to substantially degrade and release the cellulosic fibres is measured.

75 Examples of polymers having all the characteristics previously set forth including D values no greater than 5 include a copolymer of 80 parts by weight ethyl acrylate and 20 parts by weight methacrylic acid and a copolymer comprising 60 parts by weight of acrylonitrile and 40 parts by weight methacrylic acid. 80

85 As has heretofore been stated, the novel sanitary products of this invention can be prepared according to conventional means with respect to the application of the binders previously described to the biodegradable fibres. Thus, for example, a fibrous web may be formed in any suitable manner such as by carding, garneting, or by dry deposition from air suspension of the fibres and thereafter impregnated with a solution or dispersion of the binder and then oven dried at temperatures sufficiently low to prevent the binder from becoming thermally cross-linked. Although the maximum temperature will vary depending upon the particular binder, nevertheless, it has been found desirable never to exceed temperatures of 150° C. and, preferably, to operate at temperatures of from 70° to 120° C. when drying the product. 95

100 In another embodiment the binder can be applied to the fibrous webs by passing the web through nip rolls which are wet with an emulsion of the binder and thereafter dried in hot air.

105 In still another embodiment, a foamed structure can be prepared comprising the biodegradable fibres, the binder and a suitable wetting agent, preferably anionic surfactants which are well known in the art. Such a foamed structure can also be prepared by starting
110 with the fibres in the form of a web, batt or low-bonded paper and foaming in situ in the manner disclosed in U.S. Patent No. 3,306,769.

115 The sanitary products of this invention, after use, are merely placed in a conventional toilet together with an alkaline material, for instance, ammonia, sodium carbonate, ammonium borate, an alkali metal borate, phosphate or silicate, e.g. sodium borate, potassium
120 phosphate or potassium silicate, or sodium hypochlorite. Obviously, any base can be employed, such as dilute potassium hydroxide, but such a material is not generally found about the home. 125

The required alkaline material can be supplied in premeasured amounts as tablets, packaged powder or as liquid so as to minimize the inconvenience of storing, handling and measur-

ing the compounds necessary to degrade the sanitary products.

The following Examples illustrate the invention.

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EXAMPLE 1

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A monomer mixture consisting of 256.8 pounds of ethyl acrylate and 64.2 pounds of methacrylic acid is premixed and placed in a 55 gallon stainless steel drum. The initiator components, 820 grams of 30% hydrogen peroxide in 23.50 pounds of water and 452 grams of sodium formaldehyde sulfoxylate in 24.3 pounds of water are prepared in separate vessels, 1375 ml of each of the initiator component solutions are added to an agitated solution of 32.8 pounds of Alipal CO-436 wetting agent (alkylphenolethylene oxide condensation products) in 356 pounds of water. The remaining initiator components and monomer mixture are then added slowly over a period of five hours.

During the reaction, the temperature is adjusted to keep the contents of the reactor at 55 to 60° C. After all the monomers and initiators have been added, the temperature is lowered to 40° C. The resultant copolymer has a composition corresponding to an incorporation of 4 parts by weight of ethyl acrylate for every part by weight of methacrylic acid.

The above co-polymer is substantially free from cross-linking and is non-irritating to the human skin and has a D value of 2; it is used as a binder in the following manner:—

The following ingredients are placed in a 5 litre Waring Blender:

52.5 g	Shredded wood Pulp
7.5 cc	Tergitol-7 (sodium alkyl sulphite) ("Tergitol" is a Registered Trade Mark).
35 cc	The above copolymer, as an emulsion at 44% solids.
1100 cc	Water

The above formulation is whipped into a froth to a volume of 4500 cc. The foam is then poured into a pan lined with polytetrafluoroethylene and dried in an oven for 2 hours at 105° C.

The dried foam layer can be easily peeled off the pan. It is pliable and has a rough skin on the upper surface and a smooth compacted skin on the lower surface. It has dry and wet strengths and breaking elongations within the ranges specified earlier.

A 5 inch square of this material weighing 10 grams absorbs 100 millilitres of water. A diaper, 5 inches×14 inches and weighing 25 grams, when placed in a toilet pan and 2 grams sodium hydroxide added, is degraded

enough so that it can be safely flushed within 2 minutes. 60

EXAMPLE 2

2400 grams of benzene are placed in a reactor and heated to 80° C. 3 grams of benzoyl peroxide are added to the reactor and the solution swept with nitrogen. A solution of 90 grams of styrene, 180 grams of methacrylic acid, 330 grams of 2-ethylhexyl acrylate and 3 grams of benzoyl peroxide is added and the reactor heated to 80° C. After one hour at 80° C. 3 grams of benzoyl peroxide is added to the reactor and heating continued at 80° C. for two hours after which the reactor is left to cool to room temperature. One to two litres of acetone is added to the cooled reactor and the precipitated co-polymer filtered and dried. The dried polymer is dissolved in dioxane and applied to an absorbent unbound cellulose fibre pad to make diapers and sanitary napkins. The copolymer is found to be non-irritating to the human skin and to have a D value of 2. The diapers and sanitary napkins have the following physical properties. 65 70 75 80

Dry break strength	6.4 pounds	85
Wet break strength	0.8 pounds	
Dry elongation	5.6 percent	
Wet elongation	7.8 percent	

WHAT WE CLAIM IS:—

1. A diaper, sanitary napkin or like sanitary article which consists of a body of biodegradable fibres held together with a water-insoluble copolymer of at least two monomers which include an ethylenically unsaturated mono- or poly-carboxylic acid and an ethylenically unsaturated ester or nitrile, which copolymer is free from irreversible cross-linking, is non-irritating to the human skin and, while stable to fluid body discharge, degrades to release said fibres in more alkaline liquids, said article exhibiting dry and wet strengths and breaking elongations such that a one inch wide strip thereof withstands without breaking pulls of at least two pounds when dry and at least 0.5 pound when wet and extends before breaking by from 3 to 50% of its length when dry and from 3 to 25% of its length when wet. 90 95 100 105
2. A sanitary article according to Claim 1, wherein the water-insoluble copolymer has a D value, determined as herein described, not greater than 5. 110
3. A sanitary article according to Claim 2, wherein the water-insoluble copolymer is a copolymer of methacrylic acid with either ethyl acrylate or acrylonitrile. 115
4. A sanitary article according to Claim 1

or 2, wherein the biodegradable fibres are
cellulosic fibres.

5. A sanitary article according to Claim 1
and substantially as hereinbefore described.

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